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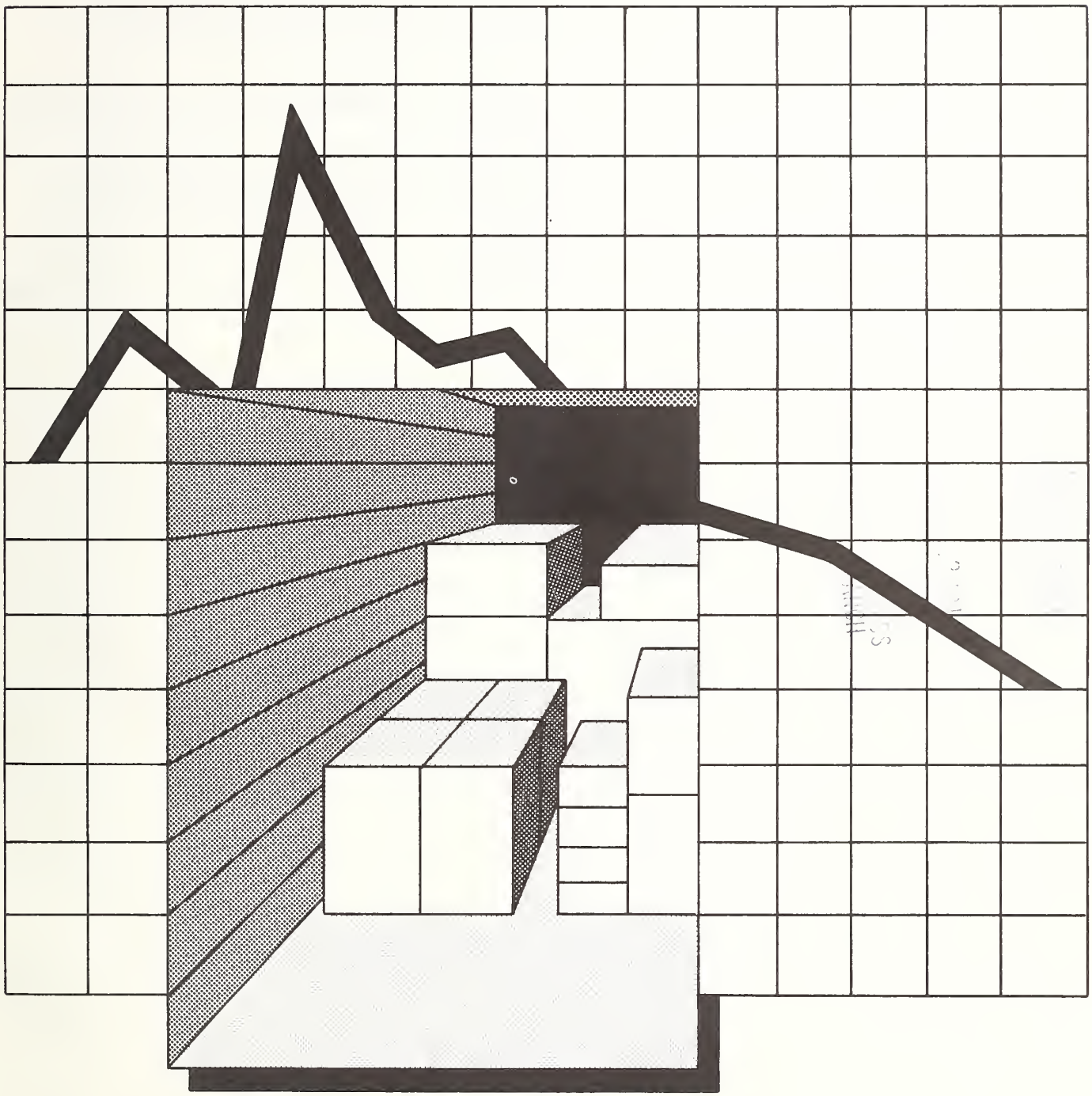
# Reducing Costs of Less-Than-Trailer-Load Purchases by Grocery Distribution Firms



# Preface

This publication reports on a continuing research program in the U.S. Department of Agriculture (USDA) to find more efficient and economical systems for moving agricultural products from producer to consumer.

Appreciation is expressed to the two wholesale-retail food distribution firms for use of their facilities to measure productivity by different receiving methods and for use of their records to project methods for reducing less-than-trailer-load (LTL) shipments.

This study was conducted under contract with the Paul F. Shaffer Co., management consultants, Miami, Fla.

Single free copies of this report are available upon request to the Market Research and Development Division, Agricultural Marketing Service, Washington, D.C. 20250.

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# Reducing Costs of Less-Than-Trailer-Load Purchases by Grocery Distribution Firms

By P. F. Shaffer and J. C. Bouma[1]

## Introduction

The manager of a food distribution warehouse is beset by opposing pressures. More warehouse space is required because merchandisers are frequently adding items to increase sales and meet competition. More items are added than dropped, to a degree that will decrease the movement of the other items in that family group. The merchandisers will order individual items in smaller quantities to maintain a desired level of inventory stock turns, and this results in more less-than-trailer-load (LTL) receipts. There is also pressure on the manager to increase warehouse labor productivity as well as to make efficient use of warehouse space. Additional items require more order selection spaces, and with decreased volume per item, more LTL receipts occur.

A 1975 survey of 129 grocery distribution warehouses indicated that, of the truck arrivals at the median firm, 60 percent were full trailer loads (FTL) and 40 percent were less-than-trailer loads (LTL). In smaller firms, 60 percent of the truck receipts were LTL.[2] Equally significant to the impact of LTL shipments on grocery receiving costs is the high proportion that is handstacked—73 percent, as compared to 39 percent for FTL shipments.

Handstacked loads are labor-intensive and tie up dock space, equipment, and personnel. Productivity for unitized unloading of trailers was 1,172 cases per worker-hour compared to 264 for LTL receiving. There is an opportunity to reduce grocery receiving costs if LTL shipments can be changed to FTL shipments or can be received on a unitized platform.

[2]Bouma, J. C. Truck Unloading of Manufacturer Shipments at Grocery Distribution Warehouses. U.S. Dept. Agr., ARS-NE-68, 23 pp. 1976.

[1]President, Paul F. Shaffer Co., Miami, Fla. 33156, and Market Research and Development Division, Agricultural Marketing Service, Washington, D.C. 20250.

## Objectives and Methodology

The first objective of this study was to measure the cost of LTL grocery receiving, and to develop and evaluate procedures for reducing both the number and cost of LTL receipts. Savings estimates in receiving costs, because of a reduced number of LTL shipments and increased frequency of unitized LTL shipments, will be developed for a varying number of receivings per week.

A secondary objective was to determine potential savings when inventory turnover is increased by more frequent deliveries, to be achieved by more combination and shared loads.

Time and cost standards for labor and equipment were developed for LTL receiving by both manual and unitized unloading. Studies were conducted in two wholesale distribution centers. Cost and productivity of LTL receiving were compared with full trailer receiving for both manual and unitized unloading. The studies included all activities relevant to receiving, from arrival at the truck receiving door to departure.

The unitized loads, both LTL and FTL, often required repalletization to other pallets. Repalletization was required when more than one item was on a unit load, when product was transferred from a 48- by 40-inch unit load to a 40- by 32-inch pallet, and for removal of one or more product layers so the unit load could be stored in warehouse pallet racks. Time expended in these activities was excluded from the study. The labor studies were elapsed time studies where the overall unloading time of all LTL loads was recorded.

Detailed time studies also were made of a representative number of loads. The latter were based on standard elemental times and include a 15-percent personal and fatigue allowance.

Labor for receiving included the driver, and/or hired lumper, and the warehouse dock forklift operator. Labor was assumed to be at the rate of $8.40 per hour, including fringe benefits. Freight rates were compared for the alternative methods of grocery shipment by trucks, full and shared loads from vendors, and LTL loads from a regional distribution warehouse or local warehouse.

Product movement by item and by vendor was analyzed in one grocery distribution warehouse to determine which supplier orders could be combined on one trailer, either by the vendor for delivery to two or more warehouses in a city, or by two closely located vendors for delivery to one grocery warehouse. The cost of dry grocery storage space and pallet racks was obtained from industry averages. This cost was then used to determine savings when inventory turnover is increased by more frequent delivery of a vendor's product line as a result of shared trailer loads.

## Grocery Receiving

Operating practices for grocery truck receiving were different for the two firms participating in the study. Firm A had over 30 receiving doors, a central check-in station for all trucks, and a varying number of forklift operators for unloading. Forklift operators entered the trailers, removed unit loads, checked merchandise, applied an inventory tag to a unit load, and moved it to the dock staging area.

Firm B had 14 receiving doors and a central check-in station. Drivers loaded a pallet, obtained a pallet jack, and moved pallet(s) to the dock for checking. Two or three receivers checked loads, and prepared and attached an inventory tag to a pallet load. Forklift operators then moved pallet loads to a second dock staging area.

**Less-than-trailer-load Purchases**

Handstack LTL receiving is a labor-intensive operation, since loads are usually small and frequently have more items than full trailer loads (FTL). In addition, warehouse management has little control of receiving productivity, other than providing drivers with a speedy check-in, a prompt door assignment, empty pallets at each door, and unloading equipment in those warehouses where the driver moves the loaded pallet onto the dock.

The only advantage of handstacked truck receiving is that the driver does most of the work, and any breakdown of layers or repalletization is done while the driver palletizes the product. Unloading labor productivity was 231 cases per worker-hour[3] in firm A and 180 in firm B as shown in table 1.

While the objective of the study was not to compare receiving standards in the two firms, possible causes for differences in productivity can be pointed out. Firm B had smaller LTL handstack loads and each load had more items than firm A. Firm B also used two pallet sizes with more product handlings. Drivers at firm B encountered delays in waiting for empty pallets and electric pallet jacks, which were shared with other drivers.

Unit loads received LTL were on pallets and occasionally on slipsheets. Some unit loads were secured with a film sleeve wrap. In firm A the forklift operator performed the entire receiving operation. In Firm B the forklift operator only entered the trailer for slipsheet loads and backhaul trailers. Unitized shipments in firm A had an unloading productivity of 790 cases per worker-hour, which was nearly 3½ times higher than handstack receiving. Labor cost was $10.63 per 1,000 cases (table 1). Unitized receiving in firm B had a combined productivity of 576 cases per worker-hour and a labor cost of $17.61 per 1,000 cases. Total worker-hour productivity with unitized loads was 2.7 times higher than handstacked loads. Firm B had higher labor requirements than firm A because they received smaller size loads with fewer cases per unit load, and movement of unit loads out of the trailer was performed by truck drivers.

**Full-trailer-load Purchases**

Labor costs and productivity for receiving full trailer loads (FTL) of groceries at the food distribution warehouse were obtained from a previous study.[4] In order to get a valid comparison of different receiving methods, the time for the driver for unitized unloading was not included in this study. The unitized receiving studies in MRR-1075 have been adjusted to include the driver's time while the trailer was being unloaded.

Firms A and B participated in the previous study along with four other firms. As shown in table 2, productivity ranged from 205 to 264 cases per worker-hour for unloading handstacked loads, and from 684 to 1,070 cases for unloading unitized loads. The relative difference in productivity for FTL handstacked and unitized receiving is approximately the same as for LTL receiving. Total labor productivity was from 3.3 to 4.1 times higher for unitized. The difference between the two receiving methods was not as significant when only the cost of warehouse labor was included in the comparison: handstacked unloading, compared with unitized unloading, was 16 percent higher in firm A and 18 percent higher in firm B.

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[3]The terms "worker-hour" and "worker-minute" are substituted throughout this report for the terms "man-hour" and "man-minute" previously used in USDA reports. The terms have identical meanings to those defined for "man-hour" and "man-minute" in the American National Standard-Industrial Engineering Terminology publication ANSI-Z94.12-1972.

[4]Bouma, J. C. and Shaffer, P. F. Systems for Handling Grocery Products From Supplier to Distribution Warehouse. U.S. Dept. Agr., MRR-1075, 44 pp. 1978.

**Table 1.—Labor requirements for receiving grocery products LTL handstacked and unitized in two firms**

| Method | Firm | Load size | Unit load size | Standard time | | | | Total | Cost per 1,000 cases[1] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Driver | Forklift operator | Checker | Total | | Dock personnel | All personnel |
| | | *Cases* | *Cases* | *.....Worker-minute per case.....* | | | | *Cases per worker-hour* | *.....Dollars.....* | |
| Handstacked | A | 475 | 35 | 0.2063 | 0.0532 | [2] | 0.2595 | 231 | 7.45 | 36.33 |
| | B | 281 | — | .2620 | .0296 | 0.0420 | .3336 | 180 | 10.02 | 46.70 |
| Unitized | A | 785 | 63 | .0439 | .0320 | [2] | .0759 | 791 | 4.48 | 10.63 |
| | B | 457 | 35 | .0336 | .0558[3] | .0364 | .1258 | 477 | 12.91 | 17.61 |

[1]Based on a labor cost, including fringe benefits, of $8.40 per hour.

[2]Checking in firm A was performed by forklift operators.

[3]Two separate operations performed: out of trailer to dock for checking and then moved to staging area.

**Table 2.—Labor requirements for receiving grocery products FTL handstacked and unitized[1]**

| Method | Firm | Load size | Unit load size | Standard time | | | | Total | Cost per 1,000 cases[1] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Driver | Forklift operator | Checker | Total | | Dock personnel | All personnel |
| | | *Cases* | *Cases* | *.....Worker-minute per case.....* | | | | *Cases per worker-hour* | *.....Dollars.....* | |
| Handstacked | A | 1142 | 34 | 0.1901 | 0.0371 | [3] | 0.2272 | 264 | 5.19 | 31.81 |
| | B | 948 | 35 | .2206 | .0296 | 0.0420 | .2922 | 205 | 10.02 | 40.91 |
| | C[4] | 1056 | — | — | — | — | .2354 | 255 | — | 32.96 |
| Unitized | A | 979 | 50 | .0320 | .0320 | [3] | .0640 | 938 | 4.48 | 8.96 |
| | B | 785 | 37 | .0282 | .0390[5] | .0215 | .0877 | 684 | 8.47 | 12.28 |
| | C[4] | 1122 | 65 | — | — | — | .0561 | 1070 | — | 7.85 |

[1]Labor requirements from U.S. Dept. Agr., MRR-1075.

[2]Based on a labor cost, including fringe benefits, of $8.40 per hour.

[3]Checking in firm A was performed by forklift operator.

[4]An average of four additional firms.

[5]Two separate operations performed; out of trailer to dock for checking and then to staging area.

## Potential Labor Savings in Grocery Receiving

There are two ways of increasing productivity in the LTL receiving operation without changing dock operating practices: upgrading LTL to full trailer loads and increasing the proportion of LTL loads that are unitized. The labor savings depends on whether the driver is included in the cost of warehouse receiving. Some say that total unloading productivity and cost are not the true measure of receiving cost to the food distribution warehouse because the driver is not on the warehouse payroll. However, the driver's compensation for unloading is included in the delivered cost of the product.

Productivity for total receiving, including the truck driver, increases an average of 14 percent when LTL loads are upgraded to FTL loads (table 3). This is a small increase compared to the more than 300-percent productivity increase when LTL loads are changed from handstacked to unitized. As shown in table 4, labor cost for warehouse receiving dock personnel is not reduced appreciably with unitized loads.

**Table 3.—Labor productivity, including truck driver and warehouse dock personnel, for grocery receiving LTL, FTL, unitized and handstacked, in two firms**

| Type of receiving | Firm A | Firm B | All firms[1] |
|---|---|---|---|
| | .... *Cases per worker-hour* .... | | |
| LTL: | | | |
| Handstacked | 231 | 180 | — |
| Unitized | 791 | 477 | — |
| FTL: | | | |
| Handstacked | 264 | 205 | 255 |
| Unitized | 938 | 684 | 1070 |

[1]Includes data obtained at four firms in addition to firms A and B.

**Table 4.—Labor cost for warehouse personnel, for grocery receiving LTL, FTL, unitized and handstacked, in two firms**

| Type of receiving | Firm A | Firm B |
|---|---|---|
| | *Dollars per 1,000 cases* | |
| Handstacked: | | |
| LTL | 7.45 | 10.02 |
| FTL | 5.19 | 10.02 |
| Unitized: | | |
| LTL | 4.48 | 12.91 |
| FTL | 4.48 | 8.47 |

In firm A, there is a potential warehouse labor saving of $2.26 per 1,000 cases by upgrading LTL handstacked loads to FTL. No measurable savings were found in firm B by upgrading handstacked loads. Savings in upgrading LTL unitized loads to FTL unitized loads totaled $4.44 in firm B while no measurable savings were found for a similar change in firm A.

Warehouses will vary not only in the tonnage received on the truck dock, but also will vary in the ratio of LTL and FTL loads and the mix of handstacked and unitized loads. In addition, the labor involved in truck receiving depends on whether the driver is included in the analysis. The basis for determining labor savings are tables 1 and 2. The potential labor savings for the two firms when LTL loads are upgraded to FTL loads, and when LTL loads are changed from handstacked to unitized, are shown in table 5.

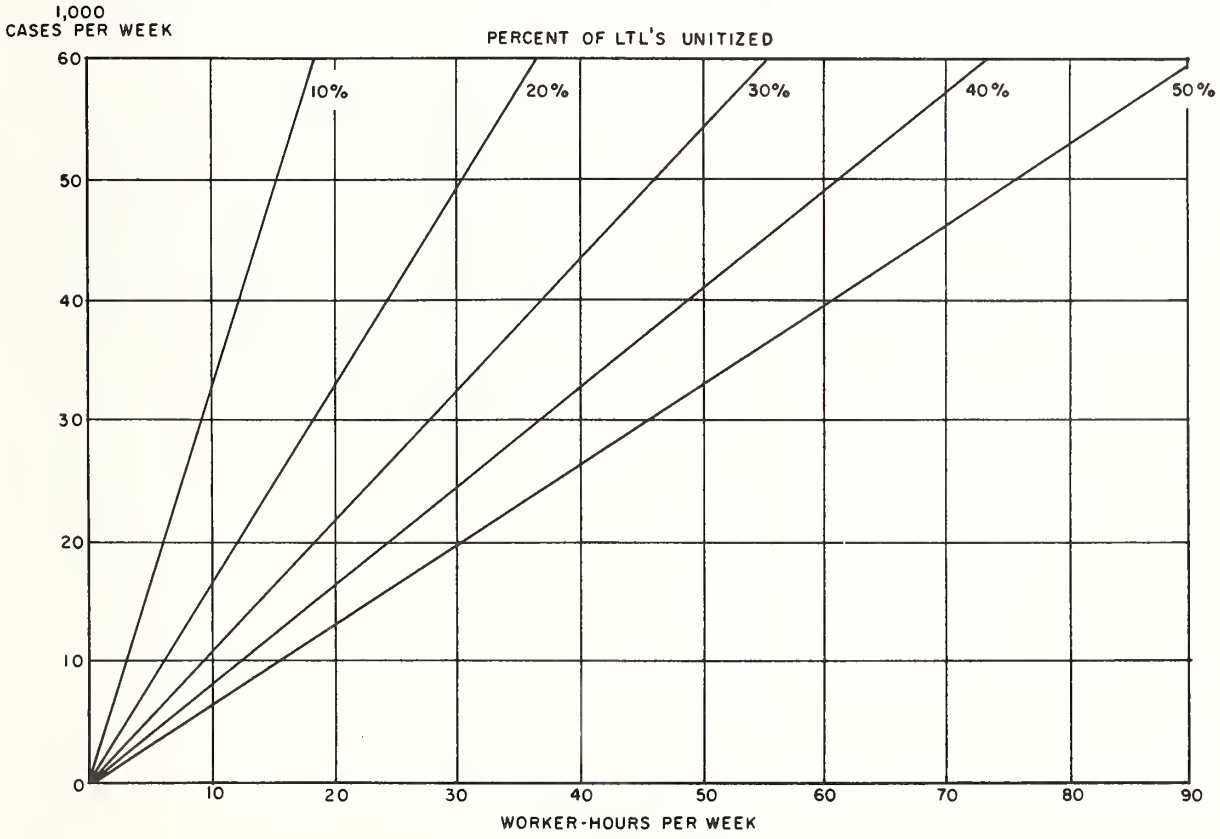
When the driver's time during unloading is excluded from the receiving studies, there are no appreciable savings by upgrading LTL from handstacked to unitized, or by changing from LTL to FTL shipping. In fact, warehouse personnel cost increased for firm B when changing LTL receiving from handstacked to unitized. Labor savings are minimal when LTL loads are upgraded to FTL loads, even when the driver's labor is included. However, the potential labor savings in firms A and B are $25.70 and $29.09 per 1,000 cases, respectively, when the driver's time is included in changing LTL handstacked loads to unitized loads.

Figure 1 illustrates the weekly worker-hour savings when LTL loads are changed from handstacked to unitized at various warehouse LTL dock receiving volumes and percentage levels. For example, with a warehouse LTL truck dock volume of 40,000 cases per week, and when 20 percent of LTL's are unitized, savings of 245 worker-hours per week are made, including the driver's time. The labor savings increase to 49 worker-hours when 40 percent of the LTL's are unitized.

**Table 5.—Labor savings for all receiving personnel and dock personnel in two firms when LTL and FTL loads are upgraded from handstacked to unitized and LTL to FTL**

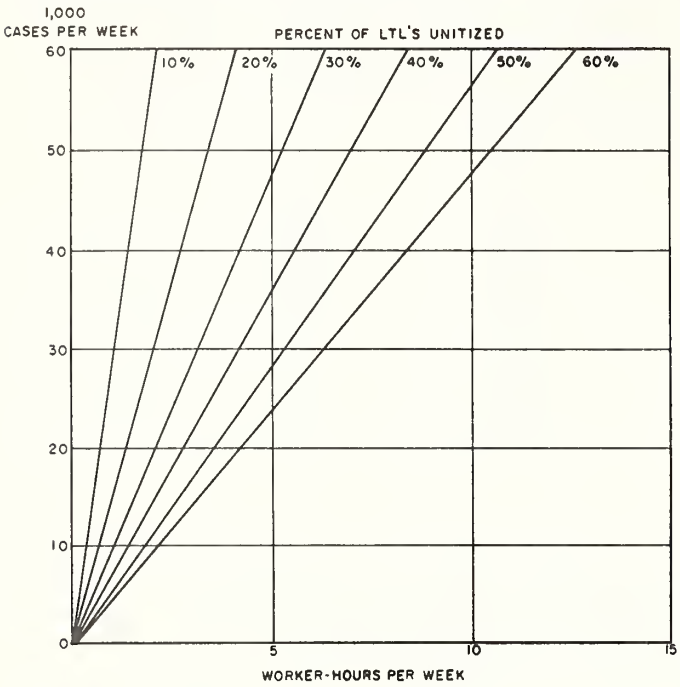
| Change | Method | Firm A | | Firm B | |
|---|---|---|---|---|---|
| | | All personnel | Dock personnel | All personnel | Dock personnel |
| | | *Dollars per 1,000 cases* | | *Dollars per 1,000 cases* | |
| LTL from handstack to unitized | Handstack | 36.33 | 7.45 | 46.70 | 10.02 |
| | Unitized | 10.63 | 4.48 | 17.61 | 12.91 |
| | Savings | 25.70 | 2.97 | 29.09 | (2.89) |
| LTL to FTL hand-stacked | LTL | 36.33 | 7.45 | 46.70 | 10.02 |
| | FTL | 31.81 | 5.19 | 40.98 | 10.02 |
| | Savings | 4.52 | 2.26 | 5.72 | 0 |
| LTL to FTL unitized | LTL | 10.63 | 4.48 | 17.61 | 12.91 |
| | FTL | 8.96 | 4.48 | 12.28 | 8.47 |
| | Savings | 1.67 | 0 | 5.33 | 4.44 |

Figure 1.—Potential weekly labor savings, including the truck driver's time, by changing varied percentages of LTL grocery loads from handstacked to unitized at different volume levels in firm A.[1]




[1]Data derived from tables 1 and 16.

Figure 2.—Potential weekly labor savings for warehouse dock personnel, excluding the truck driver, by changing varied percentages of LTL grocery loads from handstacked to unitized at different volume levels in firm A.[1]




[1]Data derived from tables 1 and 16.

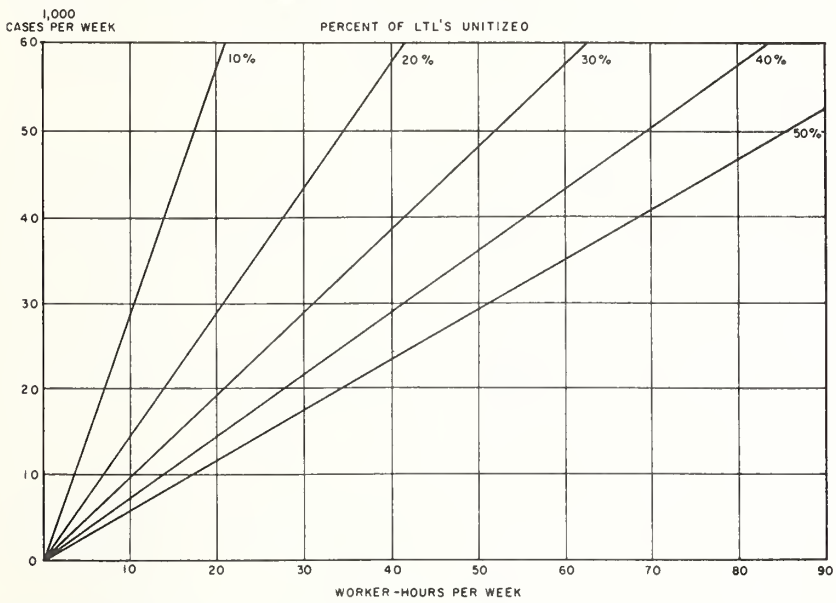
Figure 2 shows the warehouse dock personnel savings (truck driver labor is excluded). As illustrated, the savings total only 2.82 worker-hours per week in firm A when 20 percent of the LTL loads are changed from handstacked to unitized at the 40,000 cases per week receiving level, and only 5.65 worker-hours when 40 percent are changed.

The labor savings for a firm using receiving methods similar to those used in firm B are illustrated in figures 3 and 4. With a warehouse LTL receiving volume of 40,000 cases per week, and when 20 percent of the handstacked loads are changed to unitized, receiving savings, including the driver's time, will total 27.7 worker-hours weekly. If 40 percent of the loads are changed to unitized, savings will total 55.4 worker-hours weekly.

Negative savings were projected in firm B when handstacked loads are changed to unitized for LTL receiving when the driver's time is excluded. Figure 4 shows results, based on 40,000 cases and a 20-percent change from handstacked to unitized loads, of a loss of 2.82 worker-hours for receiving dock personnel. A loss of 5.65 worker-hours results with a 40-percent change.

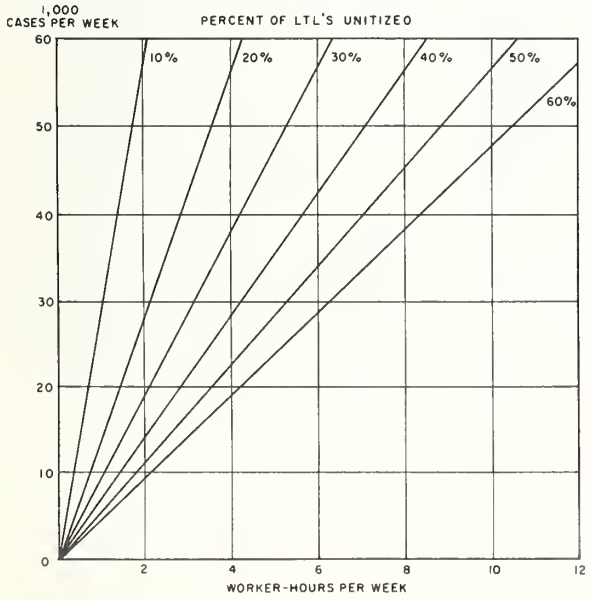
When unitized grocery loads in firm A were upgraded from LTL to FTL, savings were minimal, and were the same with or without the driver. In a warehouse with a grocery volume of 40,000 cases per week, savings were 3.2 worker-hours when 40 percent of the inbound loads were changed to FTL. Savings for firm B for upgrading loads from LTL to FTL are shown in figure 5. With a volume of 40,000 cases per week when 40 percent are FTL, labor savings are 10.2 worker-hours with the driver and 8.7 worker-hours without the driver.

Figure 3.—Potential weekly labor savings, including the truck driver's time, by changing varied percentages of LTL grocery loads from handstacked to unitized at different volume levels in firm B.[1]



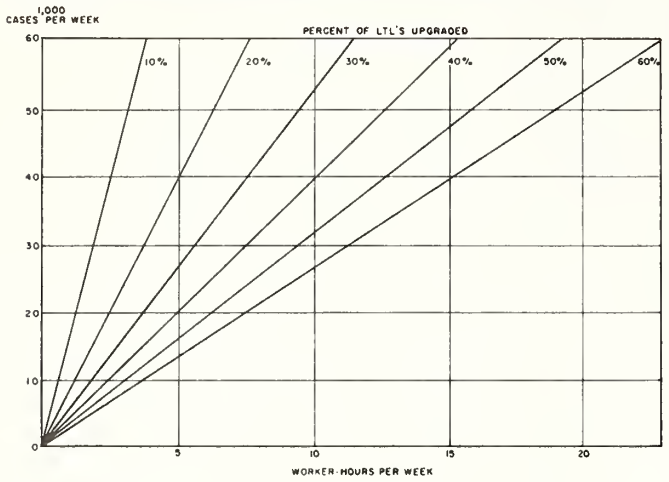

[1]Data derived from tables 1 and 17.

Figure 4.—Potential worker-hour loss for warehouse dock personnel, excluding the truck driver, by changing varied percentages of LTL grocery loads from handstacked to unitized at different volume levels in firm B.[1]




[1]Data derived from tables 1 and 17.

Figure 5.—Potential weekly labor savings, including the truck driver's time, by changing varied percentages of unitized LTL grocery loads to FTL at different volume levels in firm B.[2]




[2]Data derived from tables 1, 2, and 18.

In addition to changing from handstacked to unitized and from LTL to FTL loads, other methods can be used to reduce the cost of LTL loads. These methods include using regional consolidation warehouses, obtaining merchandise from local warehouses as backhauls on warehouse trucks, and improving operating methods and equipment at the warehouse truck receiving dock.

**Regional Consolidation Warehouses**

A link in the food distribution chain that is becoming more evident is the regional consolidation warehouse that stores products from several suppliers and combines orders going to a particular distribution warehouse in full common carrier loads. Consolidation warehouses do not take title to the product in storage and are classified, for transportation rate purposes, as in-transit warehouses. In addition, numerous suppliers have established regional distribution centers for shipping their product to food distributors.

While this study was being done, products were shipped from 15 consolidation warehouses or supplier distribution centers in five cities to one of the study cooperators. The use of consolidation or supplier distribution warehouses reduces the number of LTL receipts. The product is more likely to be unitized than if it were received LTL from a local warehouse. Freight cost will be reduced when compared to local LTL delivery, which typically costs an additional 50 cents per hundredweight (cwt). Following is an example of freight costs from the Midwest to south Florida with alternate distribution channels. A 40,000-pound load shipped directly to Miami would cost $2.82 per cwt or $1,128. The same product shipped via Atlanta, and reshipped to Miami as part of a consolidated load, would cost $3.03 per cwt or $303 for a minimum order of 10,000 pounds. The cost for local LTL delivery would be $2.82, plus $0.50 per case for delivery and $0.09 per case for local warehousing. Freight would total $3.61 per cwt or $1.118 per case (table 6). In this illustration, the use of the consolidated or supplier distribution warehouse would save $0.18 per case compared to local LTL delivery. The increasing number of consolidation and supplier distribution warehouses shows that grocery distribution firms are taking increasing advantage of this freight cost saving approach.

**Table 6.—Freight cost per 100 pounds and per case by three methods**

| Method | Dollar cost | |
|---|---|---|
| | *Per cwt* | *Per case* |
| Direct-supplier to warehouse[1] | 2.82 | 0.873 |
| Supplier through consolidated warehouse[2] | 3.03 | .938 |
| Local LTL delivery | 3.61 | 1.118 |

[1]FTL—40,000 pounds.

[2]Minimum 10,000 pounds.

### Backhauls From Local Warehouses

Grocery distribution firms can lower distribution costs by using their own fleet to pick up small orders from local warehouses. This can be done on a backhaul basis or on regularly assigned trips. Products from local supplier warehouses will be less costly if orders are placed with each warehouse a week in advance, pickup times are scheduled for the week, and pallets are exchanged. To reduce costs, load the product on pallets at the local warehouse and unload on pallets at the grocery distribution warehouse. The cost for local LTL delivery is $0.50 per cwt. Records were kept on 26 loads that were obtained from local warehouses by one of the cooperating grocery distribution firms in this study. Based on the cooperating firms' worker-hour cost of $10.40 and vehicle operating cost of $1.25 per mile, the delivery cost for merchandise from local warehouses totaled only $0.153 per cwt.

Groceries from local warehouses provide the following benefits in addition to cost savings:

1. *Better pallet control*—The driver can refuse to accept defective pallets, and merchandise can be obtained on 40- by 32-inch pallets with an exchange program which eliminates repalletizing on the warehouse dock.

2. *Reduced number of receivings*—In one week, a cooperating firm received products from 50 suppliers from local warehouses—products which were typically hand-stacked and did not arrive at the warehouse on a scheduled basis.

3. *Control of unit load tie and height*—This also eliminates breakdown of pallet loads on the receiving dock.

4. *Balanced dock receiving*—Local warehouse pickups can be scheduled during slack receiving periods, or trailers can be left with product on them at the dock.

5. *Reduced checking*—With product obtained at local warehouses checked and tagged during loading, unit loads can be placed directly in storage without checking.

### Truck Receiving Dock Operating Methods and Equipment

Methods and equipment used on the receiving dock affect LTL receiving productivity and costs. A dock should have enough receiving doors for peak periods and an appointment system[5] to balance the workload. The following methods should be used in operating a receiving dock: Assign specific receiving doors to LTL receipts, one to accommodate trucks with lower truck beds. Let warehouse personnel set the pace to minimize driver delay. Have purchase orders readily available to minimize check-in time, and empty pallets available at the doors. Speed up the truck receiving operation by using forklift operators to unload the trailers, check the product for damage, and see that the product received agrees with invoice quantities. This will lower costs and set the receiving pace.

Evidence of the lower cost of using the dock forklift operator is shown in table 1, where the cost for receiving 1,000 cases LTL unitized for dock personnel is $4.48 in firm A and $12.91 in firm B.

In firm B the driver, checker, and forklift operator all are involved in unloading and checking. The single forklift operator/checker used in firm A is more productive because handling and delays between each operation are minimized. As shown in table 7, the total labor required when three people are involved in unloading is nearly 2.3 times greater than the use of a single forklift operator/receiver. The driver alone requires more time to move unit loads to the dock with a pallet jack (2.381 worker-minutes) than the forklift operator-receiver for unloading and checking (1.892 worker-minutes). Standard time in pallets per worker-hour equals 12.0 with three people and 27.6 with one.

**Table 7.—Comparison of productivity with three workers and one unloading of palletized groceries on trucks[1]**

| Operation | Three workers | One worker |
|---|---|---|
| | ..... *Worker-minutes* ..... | |
| Driver—move product to dock | 2.381 | — |
| Checker | .968 | — |
| Forklift operator | .993 | 1.892 |
| Total | 4.342 | 1.892 |
| 15 percent personal time | .651 | .284 |
| Standard time | 4.993 | 2.176 |

[1]Appendix tables 19 and 20 provide detailed elemental time and frequencies.

[5]See footnote 3, page 4.

## Increasing Annual Inventory Turnover with Combined Trailer Loads

Inventory turnover is increased by more frequent stock replenishment and by increasing sales of an item. In this analysis we are concerned with item supply, not sales. Often a conflict exists between increasing inventory turnover and reducing the cost of the product through lower freight costs.

At one extreme are low-volume items which are obtained from a local warehouse as frequently as desired, but where freight and handling costs are high. At the other extreme is the purchase of full railcar or truck loads to receive a lower freight rate, resulting in relatively low inventory turnover. The cost of warehouse storage space and pallet racks is based on their utilization, so low inventory turnover increases item storage cost.

A possible solution to this problem is use of combined or shared loads that can be accomplished in two ways: (1) two or more suppliers with a relatively close geographic area ship product on one trailer to a single grocery distribution firm; and (2) a single supplier ships a full trailer load to be shared by two or more grocery distribution firms within a given city.

### Potential for Shared Loads

In this analysis we are not concerned with the railcar shipper or the supplier whose volume warrants frequent full trailer shipments. Our concern is the supplier who typically does not ship full trailer loads because the level of inventory turnover in the customer's warehouse would be unacceptably low. The warehouse buyer can either accept the higher inventory cost with full loads, or higher freight costs for less-than-full-trailer shipment.

The alternative to full trailer loads is the use of the regional distribution center or the local warehouses. In the geographic area where this study was conducted, products were obtained from 15 regional distribution centers and six principal local warehouses.

The buyers' order guide in one firm was analyzed to get the following information on all suppliers who shipped LTL: (1) source of the shipment (direct from supplier, a regional distribution center, or a local warehouse); (2) average weekly volume in cases and weight; (3) weighted average inventory turnover for the vendor's total product line; (4) weighted average number of cases per pallet; (5) current orders in process; and (6) inventory in cases and pallets in the warehouse.

After eliminating the obvious low-volume suppliers, delivered LTL by local warehouses, the following was the distribution of volume by source to suppliers considered potential candidates for shared loads: local LTL delivery 12 percent; regional distribution centers 33 percent; and direct shipment from supplier 55 percent. Suppliers were then organized into two groups: those in the same geographical area or city who could share loads with other suppliers going to the same food distribution warehouse; and those in areas where suppliers could not share a load, but where the firm could ship product on one trailer to two or more receivers in the same city (multireceiver). This breakdown does not imply that suppliers in the first category (multivendor loads) could not ship to two or more receivers. This survey showed 13 multivendor areas where shared loads would contribute to increased warehouse inventory turnover.

The cooperating firm received an average of 26,700 cases per week from the suppliers in multivendor areas (table 8). The effect of inventory turnover on cost was analyzed, and three west coast firms were excluded because of the high cost of freight for truck shipments. Twelve firms were potential suppliers for multireceiver shipments. Their combined average weekly volume in the cooperating firm was 10,050 cases per week (table 9). The average weekly case sales of the potential shared load suppliers was 28,600 cases and inventory turnover was 17.6 per year (table 10).

### Cost of Warehouse Storage

The major components of warehouse occupancy cost are fixed. Thus if turnover can be increased, the cost per unit stored will decrease. Major items of storage cost affected by inventory turnover are space, pallet racks, and cost of capital. Savings will be realized if a fixed storage area is reserved for an item, and inventory turnover is increased.

**Table 8.—Potential truck grocery shipments from two or more vendors to one grocery distribution warehouse[1]**

| Area of origin[1] | Movement per week | | | Inventory turnover | | Inventory | |
|---|---|---|---|---|---|---|---|
| | Cases | Weight | Pallets | Week's supply | Annual turnover | Cases | Pallets |
| | *Number* | *1,000 lb* | *Number* | *Number* | *Number* | *Number* | *Number* |
| Rochester | 3,050 | 63 | 46 | 4.0 | 13 | 12,200 | 179 |
| Central Illinois | 900 | 30 | 24 | 3.5 | 15 | 3,120 | 84 |
| Memphis | 1,850 | 62 | 32 | 4.0 | 13 | 7,400 | 125 |
| Alabama | 1,400 | 37 | 46 | 3.2 | 16 | 4,550 | 147 |
| Central Calif.[2] | 3,600 | 89 | 49 | 2.1 | 25 | 7,488 | 103 |
| Southern Calif.[2] | 2,500 | 56 | 31 | 2.6 | 20 | 6,500 | 81 |
| Louisville | 3,450 | 46 | 45 | 4.0 | 13 | 13,800 | 176 |
| Wisconsin | 1,450 | 37 | 19 | 2.6 | 20 | 3,770 | 49 |
| Minneapolis | 700 | 18 | 17 | 2.2 | 24 | 1,520 | 37 |
| New Jersey | 3,550 | 97 | 65 | 2.4 | 22 | 8,390 | 156 |
| Washington State[2] | 2,050 | 43 | 23 | 3.2 | 16 | 6,662 | 74 |
| Maine | 900 | 20 | 17 | 2.2 | 24 | 1,950 | 37 |
| Pennsylvania | 1,300 | 21 | 12 | 2.0 | 26 | 2,600 | 24 |
| Total or average | 26,700 | 619 | 426 | 2.8 | 19 | 79,950 | 1,272 |
| Total or average excluding Western States | 18,550 | 431 | 323 | 3.0 | 18 | 59,300 | 1,014 |

[1]See appendix table 22 for city of origin, items, weekly sales, and cases per pallet.

[2]Although a potential multivendor, freight costs for truck delivery may be prohibitive.

**Table 9—Potential for shared load shipment of grocery items in trucks (single suppliers to two or more food warehouses)**

| Firm | Item | Source code[1] | Movement/week | | Week's supply | Annual stock turns | Cases per pallet | Inventory | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cases | Weight | | | | Cases | Pallets |
| | | | *No.* | *1,000 lb* | *No.* | *No.* | *No.* | *No.* | *No.* |
| A | Household | R | 1,100 | 14 | 2.7 | 19 | 48 | 3,010 | 63 |
| B | Soup | D | 700 | 15 | 2.7 | 19 | 75 | 1,915 | 26 |
| C | Meal | L | 600 | 32 | 5.2 | 10 | 75 | 3,120 | 42 |
| D | Cleaners | D | 1,200 | 31 | 2.9 | 18 | 38 | 3,467 | 91 |
| E | Wine | D | 850 | 11 | 1.6 | 32 | 75 | 1,381 | 18 |
| F | Foil | D | 900 | 14 | 3.7 | 14 | 60 | 3,343 | 56 |
| G | Wrap | D | 1,100 | 18 | 2.3 | 23 | 44 | 2,487 | 57 |
| H | Household | D | 900 | 18 | 4.7 | 11 | 75 | 4,255 | 57 |
| I | Dry vegetable | D | 1,100 | 22 | 3.7 | 14 | 60 | 4,086 | 68 |
| J | Honey | D | 350 | 8 | 1.9 | 28 | 75 | 650 | 9 |
| K | Rice | D | 600 | 18 | 4.3 | 12 | 60 | 2,600 | 43 |
| L | Tea | | 650 | 9 | 4.0 | 13 | 40 | 2,600 | 65 |
| | Total or average | | 10,050 | 210 | 2.9 | 17 | 55 | 32,914 | 595 |

[1]Source code: R—regional warehouse, D—direct from supplier, L—local delivery.

**Table 10.—Summary of potential multivendor and multireceiver shipments of grocery items by truck to one food distribution warehouse**

| Type of delivery | Cases shipped weekly | Cases in inventory | Annual inventory turnover | Value of inventory |
|---|---|---|---|---|
| | *Number* | *Number* | *Number* | *Dollars* |
| Multivendor | 18,550 | 59,300 | 17.5 | 696,775 |
| Multireceiver | 10,050 | 32,914 | 17.7 | 386,740 |
| Total or average | 28,600 | 92,214 | 17.6 | 1,083,515 |

**Table 11.—Computation of annual cost per pallet space with use of pallet racks**

| Item | Cost |
|---|---|
| | *Dollars* |
| Space: | |
| Annual cost per square foot | 2.00 |
| Annual cost per bay based on 85.6 square feet | 171.20 |
| Annual cost per pallet based on 10 pallets per bay | 17.12 |
| Pallet storage racks: | |
| Annual cost per bay, including interest | 50.00 |
| Annual cost per pallet based on 10 pallets per bay | 5.00 |
| Annual storage cost per pallet | 22.12 |

**Table 12.—Cost of storage and inventory at various annual inventory levels for potential shared load items in one firm**

| Annual inventory | Weeks in inventory | Cost per pallet of product | | | Cost per 1,000 cases | Annual cost[3] |
|---|---|---|---|---|---|---|
| | | Storage[1] | Interest[2] | Total | | |
| *Number* | *Number* | *Dollars* | *Dollars* | *Dollars* | *Dollars* | *Dollars* |
| 10 | 5.20 | 2.21 | 6.42 | 8.63 | 151 | 223,992 |
| 15 | 3.47 | 1.47 | 4.28 | 5.75 | 100 | 149,241 |
| 17.6[4] | 2.95 | 1.26 | 3.63 | 4.89 | 85 | 126,920 |
| 20 | 2.60 | 1.10 | 3.21 | 4.31 | 75 | 111,866 |
| 25 | 2.08 | .88 | 2.57 | 3.45 | 60 | 89,545 |
| 30 | 1.73 | .74 | 2.14 | 2.88 | 50 | 74,750 |
| 35 | 1.49 | .63 | 1.85 | 2.48 | 43 | 64,368 |
| 40 | 1.30 | .55 | 1.57 | 2.12 | 37 | 55,025 |

[1]Based on an annual cost of $22.12 per pallet.

[2]Based on a 9-percent rate of interest (0.173 percent per week). Weeks in inventory × .00173 × $713 (cost of pallet load of product) = interest cost per pallet stored.

[3]Based on annual volume of 1,487,200 cases and 25,955 pallets @ 57.3 cases per pallet).

[4]Inventory turnover and cost in cooperating firm.

The annual cost per pallet space including warehouse space and cost of pallet racks totals $22.12 as shown in table 11. This cost is based on a cost of $2 per square foot per year for warehouse space and a cost of $475 per pallet rack bay installed.

The longer an item remains in inventory, the more capital is required for financing. In this study, the cost of capital is computed at 9 percent, and interest is charged based on the average number of weeks a supplier's product will remain in storage. The cost per pallet varies from $6.42 with 10 stock turns to $1.57 with 40 stock turns. The cost for storage and capital varies from $8.63 per pallet for 10 inventory turns to $2.12 per pallet for 40 inventory turns as shown in table 12. The average stock turns for potential shared load shippers was 17.6 per year in the cooperating firms.

If, through shared load shipment, the inventory turnover for these items can be increased to 20 per year, the savings in cost of inventory would be $10 per 1,000 cases, or $15,054 per year. Shared loads also will increase the possibility of unitized shipment with resulting warehouse receiving savings. When the load moves directly from supplier to receiver it is easier to specify the method of shipment; that is, palletized, slip-sheet, and case tie and height on the unit load. When shipped through a regional distribution center or a local warehouse, there is a greater chance for the unitization to deteriorate or to be changed to a hand-stacked delivery.

**Cost of Freight With Different Distribution Systems**

Almost without exception, freight for truck delivery of dry grocery items is prepaid, and is included in product cost. The FOB supplier cost also includes, when applicable, broker's commission, regional distribution center handling, driver unloading, stopoff or drop charges, and local warehousing and delivery. Although there are published tariffs for all dry grocery items, it is not unusual for deviations from the tariff to occur. For example, the established rate for a 40,000-pound load for a route was $2.65 cwt, yet drivers would bid as low as $2.30 cwt for the load. In another instance the freight, when expressed as the cost per mile, was 75 cents from the supplier plant to a regional distribution center 700 miles distant, yet was $1.10 per mile for delivery from the supplier plant to the customer, another 700 miles beyond the distribution center. The availability of return loads has an effect on the actual freight charged for a given trip. There are rates for truck shipment from the west coast to the east coast, but they are meaningless because it is more economical to ship by rail or boat to a regional distribution center and then by truck to the customer.

To determine the effect of freight costs on inventory turnover, rates for a typical item from each of three suppliers were compared under different distribution situations. In each instance the customer is in south Florida. The supplier for item A is in the middle Atlantic area, the supplier for item B is in the Midwest, and the supplier for item C is in the Pacific Northwest. The supplier of item C was included because the volume, even through a regional distribution center, would not justify a 100,000-pound railcar shipment.

The distribution systems by volume are direct delivery from supplier to customer, 55 percent; shipment via regional distribution center, 33 percent; and via local warehouse with delivery either by warehouse or customer pickup, 12 percent. Direct delivery was based on 40,000-pound loads. Where possible, shipments via regional distribution centers were for 20,000-pound partial loads. No specified volume was set for local warehouse distribution. The stopoff or drop charge for a shared load was assumed to be $35; it typically varies from $30 to $40.

Shared loads will contribute to higher inventory turnover and store savings. Will shared loads lower overall freight costs? The analysis concerns the suppliers shown in tables 8 and 9. For each of the three sample items, the system of distribution is compared with shared loads direct from the supplier. There is a net increase in freight when the shared load is compared to direct delivery because of the stopoff charge. The added cost of freight for shipment via the regional distribution center varies from 5 cents for item B to 28 cents for item C (table 13). The supplier of item B has structured freight charges to favor the regional distribution center. This is because they have a limited product line, and orders per customer typically are less-than-full-trailer loads.

There was a net freight savings over the regional warehouse or local delivery with shared loads which ranged from 2.2 cents per case for supplier B to 14.2 cents per case for supplier C. The average freight savings for shared load shipment in the cooperating firm would be 8.3 cents per case and $4.76 per pallet, based on an average unit load of 57.3 cases. The warehouse received 1,487,000 cases per year from suppliers who were potential shippers of shared loads. The potential annual savings would be $123,420 in freight costs if all suppliers were to participate in the shared load program.

Table 13.—Freight savings per case for three vendor items when shipping shared loads compared with direct delivery, regional distribution center delivery, and local delivery[1]

| Vendor item | Shipping method[2] | Loss per case | Receipts by distribution system |
|---|---|---|---|
| | | *Cents* | *Percent* |
| A | Direct-shared load | −3 | 55 |
| | Regional distribution center | 23 | 33 |
| | Local delivery | 21 | 12 |
| | Weighted average | 8.5 | 100 |
| B | Direct-shared load | −3 | 55 |
| | Regional distribution center | 5 | 33 |
| | Local delivery | 15 | 12 |
| | Weighted average | 2.2 | 100 |
| C | Direct-shared load | −3 | 55 |
| | Regional distribution center | 28 | 33 |
| | Local delivery | 47 | 12 |
| | Weighted average | 14.2 | 100 |
| | Average loss per case | 8.3 | |

[1]Each distribution system is compared with direct delivery to customer in a shared load. Detailed costs for various load sizes are shown in table 22.

[2]Local delivery costs are based on customer pickup.

In the analysis of product movement of the cooperating firm there was no significant difference in inventory turnover for the different distribution systems. In addition, there was no correlation between sales per week and inventory turnover that would permit the determination of inventory turnover at the volume that might be achieved by shared loads. There will be an inventory storage savings with increased inventory turnover, and a freight savings depending on the number of suppliers that participate in a shared load program. If 50 percent of the cooperating firm's suppliers participate in the shared load program, the savings will range from $41.50 per 1,000 cases for the present level of inventory turnover (17.6) to $89.84 for 40 stock turns (table 14).

Suppliers most likely to ship shared loads are those who ship direct to the customer. They represent 55 percent of the volume of the potential shared load suppliers. This group of suppliers averages 17.9 inventory turns in the cooperating firm. Their average volume is 610 cases per week (a full trailer load is 1,740 cases at 23 pounds per case). If direct shippers would ship twice as often by shared loads, the inventory turnover would increase to 35.8. Local deliveries currently have 27 inventory turns, and shipments from regional distribution centers have 19.3 inventory turns per year. More frequent shipments by direct shippers would increase total inventory turnover to 29.3 as shown in table 15.

A conservative estimate of savings would be 50-percent participation, with shared loads resulting in an annual inventory turnover of 30 which, according to table 14, would be $76.58 per 1,000 cases, or $113,890 per year based on an annual volume of 1,487,200 cases. Although direct shippers are likely to participate, a firm should examine all shipments from regional distribution centers. This may not result in increased inventory turnover, but would reduce freight costs approximately 16 cents per case. Savings opportunities through shared loads and increased inventory turnover are real and should be fully explored by grocery distribution firm buyers.

**Table 14.—Savings per 1,000 cases for storage space and freight at different annual inventory turnover rates**

| Annual inventory turnover | Storage savings per 1,000 cases | Storage and freight savings based on percentage participation | | | | | |
|---|---|---|---|---|---|---|---|
| | | *Percent* | | | | | |
| | | 20 | 30 | 40 | 50 | 75 | 100 |
| *No.* | *Dollars* | *Dollars per 1,000 cases* | | | | | |
| 17.6 | 0 | 16.60 | 24.90 | 33.20 | 41.50 | 62.25 | 83.00 |
| 20 | 10.12 | 26.72 | 39.91 | 43.32 | 51.62 | 72.37 | 93.12 |
| 25 | 25.13 | 41.73 | 54.92 | 58.33 | 66.63 | 87.38 | 108.13 |
| 30 | 35.08 | 51.68 | 64.87 | 68.28 | 76.58 | 97.33 | 118.08 |
| 35 | 42.06 | 58.66 | 71.85 | 75.26 | 83.56 | 104.31 | 125.06 |
| 40 | 48.34 | 64.94 | 78.13 | 81.54 | 89.84 | 110.59 | 131.34 |

**Table 15.—Influence of sharing loads for direct shipment on overall LTL inventory turnover**

| Source of shipment | Annual inventory turnover | | Portion of LTL volume |
|---|---|---|---|
| | Present | Potential | |
| | *Number* | *Number* | *Percent* |
| Direct shippers | 17.9 | 35.8 | 55 |
| Regional distribution centers | 19.3 | 19.3 | 33 |
| Local deliveries | 27.0 | 27.0 | 12 |
| Weighted average/ total | 19.5 | 29.3 | 100 |

## CONCLUSIONS

The truck receiving dock of the wholesale food warehouse is the focus of two companion studies which show methods of reducing food distribution costs—improving the LTL receiving operation and improving inventory turnover through shared loads. They are interrelated because the products involved are typically lower-volume items.

Less-than-full-trailer loads (LTL) have long been a problem because of the frequency of receipts, the many low-volume items, and inefficient handling methods. They are an essential part of the distribution firm's merchandise assortment and cannot be eliminated merely because of high handling costs and their negative impact on inventory turnover. Another contributor to lower inventory turnover is ordering of full truck loads of average to low-volume items to reduce freight costs.

There are several ways to lower the cost of LTL receiving. The most obvious appears to be the change of LTL to full-trailer-load (FTL) shipments. The extent of labor savings depends on whether the driver's time during unloading is included in worker-hours per load. This factor is more important when handstacked loads are upgraded to unitized (usually on pallets). If LTL receiving is inefficient, the obvious improvement is unitization—either on pallets or slipsheets. The savings are dramatic when the driver's time is included; productivity with pallets is 3.5 times greater than handstack in unloading.

When only warehouse personnel are included in the receiving analysis, there was a slight saving in one firm and a loss in the other. The advantage of upgrading LTL to FTL loads or changing from handstack to unitized is not in labor savings to the warehouse. Increasing the number of FTL shipments would reduce the number of trucks unloaded, and changing from handstack to unitized will speed up the unloading. The driver is reimbursed by the shipper, whether or not assistance is provided in unloading. If the warehouse is to reduce labor costs by receiving unitized loads, there must be a change in tariffs to compensate the receiving warehouse for unloading trailers. The existing tariff structure has been a prime factor in deterring receivers from pushing for more unitization.

Until there is a change in tariff regulations, the wholesale food warehouse will have to look elsewhere for ways to reduce LTL receiving costs. The use of wholesale food warehouse trailers to pickup LTL shipments in local warehouses will reduce costs threefold for those items. Increased use of the regional distribution centers, where several suppliers' LTL shipments are combined on a trailer, will lower freight and delivery costs, and reduce the number of receivings. The use of one person to unload, check, and move to storage will increase dock unloading productivity from 690 to 1,580 cases per worker-hour, when compared to separate persons performing the functions.

Shared or combined loads is not a new concept; it has been used on a small scale by one supplier shipping to two or more food warehouses in one metropolitan area. In a sense, the mixed loads from the regional distribution center are multivendor shared loads. In the analysis of item movement by vendor, all obvious local LTL shipments were omitted from consideration for shared loads. Half of the potential candidates were selected as multivendor or multireceiver shippers. Their combined annual volume with the cooperating firm was approximately 1.5 million cases per year. If all of the direct-to-customer shippers would participate in the program, stock turns for the 1.5 million case annual tonnage would increase from 17.6 to 29.3 and lower inventory storage costs by approximately $52,000 per year. In addition there are shippers who use regional distribution centers who could convert to direct-to-customer shippers via shared loads.

The shared load program will also reduce freight costs. A survey of three shippers showed the average freight savings to be 8.3 cents per case. A combination of the increased inventory turnover and the reduced freight rates should be sufficient incentive for the grocery buyer to initiate, or expand, an existing program of shared loads. If an LTL can become a shared load, there may be no reduction in annual turnover, but the prepaid cost of merchandise will decrease. The improvement of LTL receiving and inventory reduction have much in common and merit the attention of the total wholesale food distribution industry.

**Table 16.—Weekly worker-hour savings by changing a varying percentage of LTL grocery loads from handstack to unitized by weekly case volume in firm A**

| Weekly volume | Percentage of receipts changed from handstacked to unitized | | | | | |
|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 |
| *1,000 cases* | | | *Total worker-hours*[1] | | | |
| 5 | 1.5 | 3.1 | 4.6 | 6.1 | 7.6 | 9.2 |
| 10 | 3.1 | 6.1 | 9.2 | 12.2 | 15.3 | 18.4 |
| 20 | 61.1 | 12.2 | 18.4 | 24.5 | 30.6 | 36.7 |
| 40 | 12.2 | 24.5 | 36.7 | 49.0 | 61.2 | 73.4 |
| 60 | 18.4 | 36.7 | 55.1 | 73.4 | 91.8 | 110.2 |
| 80 | 24.5 | 49.0 | 73.4 | 97.9 | 122.4 | 146.9 |
| 100 | 30.6 | 61.2 | 91.8 | 122.4 | 153.0 | 183.6 |
| | | | *Receiving dock worker-hours* | | | |
| 5 | .18 | .35 | .53 | .71 | .88 | 1.06 |
| 10 | .35 | .71 | 1.06 | 1.41 | 1.76 | 2.12 |
| 20 | .71 | 1.41 | 2.12 | 2.82 | 3.53 | 4.24 |
| 40 | 1.41 | 2.82 | 4.24 | 5.65 | 7.06 | 8.47 |
| 60 | 2.12 | 4.24 | 6.35 | 8.47 | 10.59 | 12.71 |
| 80 | 2.82 | 5.65 | 8.47 | 11.30 | 14.12 | 16.94 |
| 100 | 3.53 | 7.06 | 10.59 | 14.12 | 17.65 | 21.18 |

[1]Based on savings of 3.06 worker-hours per 1,000 cases, including the truck driver's time.

[2]Based on savings of 0.353 worker-hour per 1,000 cases for warehouse receiving personnel.

**Table 17.—Weekly worker-hour savings or loss by changing a varying percentage of LTL grocery loads from handstack to unitized by weekly case volume in firm B**

| Weekly volume | Percentage of receipts changed from handstacked to unitized | | | | | |
|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 |
| *1,000 cases* | | | *Total worker-hours*[1] | | | |
| 5 | 1.73 | 3.46 | 5.20 | 6.93 | 8.66 | 10.39 |
| 10 | 3.46 | 6.93 | 10.39 | 13.85 | 17.32 | 20.78 |
| 20 | 6.93 | 13.85 | 20.78 | 27.70 | 34.63 | 41.56 |
| 40 | 13.85 | 27.70 | 41.56 | 55.41 | 69.26 | 83.11 |
| 60 | 20.78 | 41.56 | 62.33 | 83.11 | 103.89 | 124.66 |
| 80 | 27.70 | 55.41 | 83.11 | 110.82 | 138.52 | 166.22 |
| 100 | 34.63 | 69.26 | 103.89 | 138.52 | 173.15 | 207.78 |
| | | | *Receiving dock worker-hours*[2] | | | |
| 5 | −.17 | −.34 | −.52 | −.69 | −.86 | −.1.03 |
| 10 | −.34 | −.69 | −1.03 | −1.37 | −1.72 | −2.06 |
| 20 | −.69 | −1.37 | −2.06 | −2.74 | −3.43 | −4.12 |
| 40 | −1.37 | −2.74 | −4.12 | −5.49 | −6.86 | −8.23 |
| 60 | −2.06 | −4.12 | −6.17 | −8.23 | −10.29 | −12.34 |
| 80 | −2.74 | −5.49 | −8.23 | −10.98 | −13.72 | −16.46 |
| 100 | −3.43 | −6.86 | −10.29 | −13.72 | −17.15 | −20.58 |

[1]Based on savings of 3.463 worker-hours per 1,000 cases, including the truck driver's time.

[2]Based on a loss of 0.343 worker-hour per 1,000 cases for warehouse receiving personnel.

**Table 18.—Weekly worker-hour savings by changing a varying percentage of unitized grocery loads from LTL to FTL by weekly case volume in firm A**

| Weekly volume | Percentage of loads changed from LTL to FTL | | | | | |
|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 |
| *1,000 cases* | *Worker-hours*[1] | | | | | |
| 5 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
| 10 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 |
| 20 | 0.4 | 0.8 | 1.2 | 1.6 | 2.0 | 2.4 |
| 40 | 0.8 | 1.6 | 2.4 | 3.2 | 4.0 | 4.8 |
| 60 | 1.2 | 2.4 | 3.6 | 4.8 | 6.0 | 7.2 |
| 80 | 1.6 | 3.2 | 4.8 | 6.4 | 8.0 | 9.6 |
| 100 | 2.0 | 4.0 | 6.0 | 8.0 | 10.0 | 12.0 |

[1]Labor savings are the same whether or not driver is included—0.198 worker-hour per 1,000 cases.

**Table 19.—Weekly worker-hour savings by changing a varying percentage of unitized grocery loads from LTL to FTL by weekly case volume in firm B[1]**

| Weekly volume | Percentage of receipts changed from LTL to FTL | | | | | |
|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 |
| *1,000 cases* | *Worker-hours*[1] | | | | | |
| 5 | 0.30 | 0.60 | 0.90 | 1.20 | 1.50 | 1.81 |
| 10 | 0.60 | 1.20 | 1.81 | 2.41 | 3.01 | 3.61 |
| 20 | 1.20 | 2.41 | 3.61 | 4.81 | 6.02 | 7.22 |
| 40 | 2.41 | 4.81 | 7.22 | 9.63 | 12.04 | 14.44 |
| 60 | 3.61 | 7.22 | 10.80 | 14.44 | 18.05 | 21.66 |
| 80 | 4.81 | 9.63 | 14.44 | 19.26 | 24.07 | 28.88 |
| 100 | 6.02 | 12.04 | 18.05 | 24.07 | 30.08 | 36.10 |

[1]Based on savings of 0.602 worker-hour per 1,000 cases for receiving dock personnel.

**Table 20.—Production standard for unitized truck receiving with a 3-worker crew: driver, checker, and forklift operator**

| Personnel | Element | Total time per element | Frequency element occurs | Weighted element time per trip |
|---|---|---|---|---|
| | *Description* | *Worker-minute* | *Percent* | *Worker-minute* |
| Driver: | | | | |
| | Move pallet to dock | 1.582 | 100.0 | 1.582 |
| | Obtain pallet jack | 1.334 | 42.5 | .567 |
| | Delays | 2.667 | 7.5 | .200 |
| | Miscellaneous | 1.300 | 2.5 | .032 |
| Subtotal | | | | 2.381 |
| Checker/receiver: | | | | |
| | Check and prepare tag | .319 | 100.0 | .319 |
| | Tag product | .157 | 100.0 | .157 |
| | To desk | .155 | 71.4 | .111 |
| | Check out bills | 3.617 | 8.6 | .311 |
| | Miscellaneous | .817 | 8.6 | .070 |
| Subtotal | | | | .968 |
| Forklift operator: | | | | |
| | Engage pallet | .192 | 100.0 | .192 |
| | To storage | .368 | 100.0 | .368 |
| | Return to dock | .190 | 100.0 | .190 |
| | Double-up pallets | .575 | 10.0 | .058 |
| | Rehandle cases | .538 | 12.0 | .064 |
| | Obtain MT pallets | 3,900 | 2.0 | .078 |
| | Miscellaneous | 2.150 | 2.0 | .043 |
| Subtotal | | | | .993 |
| Total per trip | | | | 4.342 |
| Personal allowance (15 percent) | | | | .651 |
| Standard per trip | | | | 4.993 |
| Standard number of trips per worker-hour | | | | 12.017 |

Table 21.—Potential for shipment of shared grocery loads of grocery items from two or more suppliers by city of origin to one cooperating firm

| Origin city-firm | Source | Sales per week | | Annual inventory turns | Cases per pallet | Volume ordered | |
|---|---|---|---|---|---|---|---|
| | | | | | | Current[2] | On order[3] |
| | *Code*[1] | *Cases* | *1,000 pounds* | *Number* | *Number* | *.....1,000* | *pounds.....* |
| Rochester, N.Y. | | | | | | | |
| A | R | 900 | 18 | 8 | 55 | 0 | 26 |
| B | D | 1100 | 24 | 12 | 84 | 0 | 20 |
| C | D | 550 | 10 | 18 | 50 | 0 | 24 |
| D | D | 500 | 11 | 20 | 80 | 0 | 22 |
| Total | | 3050 | 63 | 13 | | 0 | 92 |
| Central Ill. | | | | | | | |
| A | D | 200 | 5 | 14 | 100 | 18 | 9 |
| B | D | 700 | 25 | 15 | 32 | 20 | 12 |
| | | 900 | 30 | 15 | | 38 | 21 |
| Memphis | | | | | | | |
| A | D | 250 | 6 | 19 | 48 | 21 | 21 |
| B | D | 900 | 18 | 10 | 100 | 43 | 58 |
| C[4] | D | 150 | 8 | (46) | 40 | 0 | 26 |
| D | D | 550 | 30 | 6 | 40 | 51 | 44 |
| | | 1850 | 62 | 13 | | 115 | 149 |
| Birmingham-Montgomery | | | | | | | |
| A | D | 600 | 17 | 17 | 30 | 0 | 36 |
| B | D | 650 | 12 | 16 | 36 | 4 | 10 |
| C[4] | L | 150 | 8 | (132) | 20 | 0 | 12 |
| | | 1400 | 37 | 16 | | 4 | 58 |
| Central Calif. | | | | | | | |
| A | R | 650 | 13 | 30 | 75 | 14 | 9 |
| B | D | 650 | 26 | 26 | 60 | 0 | 28 |
| C | R | 300 | 7 | 27 | 68 | 5 | 12 |
| D | R | 600 | 7 | 18 | 120 | 8 | 7 |
| E | D | 1400 | 36 | 26 | 70 | 0 | 26 |
| | | 3600 | 89 | 25 | | 27 | 82 |
| Southern Calif. | | | | | | | |
| A | R | 500 | 20 | 13 | 40 | 0 | 24 |
| B | R | 1050 | 16 | 17 | 112 | 0 | 47 |
| C | R | 250 | 6 | 14 | 75 | 3 | — |
| D | L | 700 | 14 | 31 | 100 | 11 | 10 |
| Total | | 2500 | 56 | 20 | | 14 | 81 |
| Louisville | | | | | | | |
| A[4] | D | 500 | 8 | (109) | 40 | 17 | 44 |
| B | D | 450 | 8 | 20 | 95 | 10 | 14 |
| C | R | 2500 | 30 | 12 | 90 | 18 | 21 |
| Total | | 3450 | 46 | 13 | | 45 | 79 |

| Origin city-firm | Source | Sales per week | | Annual inventory turns | Cases per pallet | Volume ordered | |
|---|---|---|---|---|---|---|---|
| | | | | | | Current[2] | [3] |
| | *Code*[1] | *Cases* | *1,000 pounds* | *Number* | *Number* | *.....1,000* | *pounds.....* |
| Wisconsin | | | | | | | |
| A | R | 350 | 6 | 17 | 45 | 0 | 21 |
| B | R | 700 | 21 | (31) | 120 | 0 | 116 |
| C | L | 400 | 10 | 22 | 75 | 18 | 5 |
| Total | | 1450 | 37 | 20 | | 18 | 142 |
| Minneapolis | | | | | | | |
| A | L | 250 | 4 | 36 | 43 | 7 | 8 |
| B[4] | L | 300 | 5 | (132) | 55 | 0 | 12 |
| C | D | 150 | 9 | 4 | 24 | 41 | 125 |
| Total | | 700 | 18 | 24 | | 48 | 145 |
| New Jersey | | | | | | | |
| A | D | 550 | 11 | 12 | 88 | 7 | 17 |
| B | D | 150 | 5 | 10 | 42 | 84[4] | 15 |
| C | L | 350 | 15 | 27 | 50 | 0 | 9 |
| D | R | 1100 | 22 | 23 | 60 | 0 | 48 |
| E | D | 1100 | 35 | 27 | 45 | 42 | 6 |
| F | L | 300 | 9 | 23 | 52 | 11 | 0 |
| Total | | 3550 | 97 | 22 | | 144 | 95 |
| Washington State | | | | | | | |
| A | L | 1300 | 26 | 17 | 80 | 23 | 23 |
| B | L | 550 | 11 | 14 | 140 | 3 | — |
| C | L | 200 | 6 | 16 | 68 | 24 | 5 |
| Total | | 2050 | 43 | 16 | | 50 | 28 |
| Maine | | | | | | | |
| A | D | 750 | 16 | 26 | 85 | 0 | 44 |
| B | D | 150 | 4 | 11 | 20 | 20 | 0 |
| Total | | 900 | 20 | 24 | | 20 | 44 |
| Pennsylvania | | | | | | | |
| A | D | 1000 | 14 | 26 | 160 | 0 | 37 |
| B[4] | D | 300 | 7 | (67) | 47 | 10 | 21 |
| Total | | 1300 | 21 | 26 | | 10 | 58 |
| Grand total | | 26,700 | 619 | 19 | | 533 | 1,074 |

[1]

[2]Orders being processed at warehouse.

[3]Orders placed with supplier.

[4]Item on sale.

Table 22.—Examples of freight costs for three items from three areas by different distribution systems for obtaining grocery products by truck from suppliers

| Item[1] | Method of shipment | Item cost per case | Freight cost per 100 lb | Freight cost per case | Other costs per case | Total freight and other costs per case |
|---|---|---|---|---|---|---|
| | | | | *Dollars* | | |
| A | Delivery from vendor: (40,000-lb load) | | | | | |
| | Direct to customer | 9.77 | 2.09 | 0.61 | — | 0.61 |
| | Shared load | 9.77 | 2.09 | .61 | [2]0.03 | .64 |
| A | Regional distribution center: | | | | | |
| | 40,000-lb load | 9.91 | 2.65 | .77 | — | .77 |
| | 24,000-lb load | 10.01 | 3.00 | .87 | — | .87 |
| | 9,000-lb load | 10.31 | 4.04 | 1.17 | — | 1.17 |
| A | Delivery via local warehouse: | | | | | |
| | Customer pickup | 9.86 | 2.48 | .72 | [3].13 | .85 |
| | Warehouse delivery | 9.86 | 2.48 | .72 | [4].24 | .96 |
| B | Delivery from vendor: (40,000-lb load) | | | | | |
| | Direct to customer | | 2.82 | .87 | — | .87 |
| | Shared load | | 2.82 | .87 | [2].03 | .90 |
| B | Regional distribution center: | | | | | |
| | 40,000-lb load | | 2.88 | .89 | — | .89 |
| | 30,000-lb load | | 2.97 | .92 | — | .92 |
| | 20,000-lb load | | 3.06 | .95 | — | .95 |
| | 10,000-lb load | | 3.21 | .99 | — | .99 |
| B | Delivery via local warehouse: | | | | | |
| | Customer pickup | | 2.92 | .91 | [3].14 | 1.05 |
| | Warehouse delivery | | 2.92 | .91 | [4].24 | 1.15 |
| C | Delivery from vendor: (40,000-lb load) | | | | | |
| | Direct to customer | 7.22 | 4.07 | .61 | — | .61 |
| | Shared load | 7.22 | 4.07 | .61 | [2].02 | .63 |
| C | Regional distribution center | | | | | |
| | 10,000-lb load | 7.52 | 6.07 | .91 | — | .91 |
| | 5,000-lb load | 7.60 | 6.86 | — | — | 1.03 |
| C | Delivery via local warehouse: | | | | | |
| | Customer pickup | 7.67 | 7.34 | .99 | [3].11 | 1.10 |
| | Warehouse delivery | 7.67 | 7.34 | .99 | [4].16 | 1.15 |

[1]Item A has 24 packages of 16 oz in a 29-lb case, or 24/16 oz, 29 lb; item B, 24/18 oz, 31 lb; and item C, 12/16 oz, 15 lb.

[2]Stopoff or drop charge is $35 per load.

[3]Includes 9 cents per case for warehousing and 15 cents per cwt for customer pickup.

[4]Includes 9 cents per case for warehousing and 50 cents per cwt for delivery.

**Table 23.—Production standard for unitized truck receiving with one person: a forklift operator who unloads, checks, and places merchandise on dock for later storage**

| Element description | Total time per element | Frequency element occurs | Weighted elemental time |
|---|---|---|---|
| | *Worker-minute* | *Percent* | *Worker-minute* |
| Into trailer, engage pallet | 0.378 | 100.0 | 0.378 |
| To dock | .192 | 100.0 | .192 |
| Check and tag load | .286 | 119.2 | .341 |
| To storage line | .336 | 107.7 | .362 |
| To tailgate for restacking | .166 | 11.5 | .019 |
| Check invoices | .754 | 11.5 | .087 |
| Talk to driver | .270 | 3.8 | .010 |
| Check out load | 1.004 | 9.0 | .090 |
| Bills to desk | 2.310 | 2.6 | .060 |
| Delays | .862 | 12.8 | .110 |
| Dock plate | .480 | 2.6 | .012 |
| Pick up fallen case | .380 | 2.6 | .010 |
| Obtain MT pallets | .466 | 11.5 | .054 |
| Load MT pallets | .825 | 2.6 | .021 |
| Bad pallet | .560 | 1.3 | .007 |
| Maneuver in trailer | .313 | 9.0 | .028 |
| Remove 1st pallet | .355 | 2.6 | .009 |
| Double pallets | .683 | 3.8 | .026 |
| Cruise | .447 | 7.7 | .034 |
| Prepare tags | .035 | 119.2 | .042 |
| Total per trip | | | 1.892 |
| Personal allowance (15 percent) | | | .284 |
| Standard per trip | | | 2.176 |
| Standard number of trips per worker-hour | | | 27.574 |